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A COMPREHENSIVE PROGRAM FOR WATER POLLUTION CONTROL FOR THE MINNESOTA RIVER BASIN DEVELOPED BY THE STATE WATER POLLUTION CONTROL AGENCIES OF IOWA, MINNESOTA, AND SOUTH DAKOTA

Public Health Service
Washington, D. C.

1954

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Water Pollution Series No. 64

A COMPREHENSIVE PROGRAM FOR WATER POLLUTION CONTROL

for the

MINNESOTA RIVER BASIN

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Springfield VA 22151

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

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for the

MINNESOTA RIVER BASIN

Developed by the State Water Pollution Control Agencies

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U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service

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FOREWORD

Our country's development over the past 50 years has been marked by tremendous progress in many fields. It has made possible great gains in the health, comfort, and well-being of the people. But it has not been without cost. Part of the cost has been the damage to the Nation's water resources that has resulted from wastes discharged to the streams by our growing cities and industries. All water uses have been affected - public water supplies, recreation, agriculture, industry, fish and aquatic life.

In enacting the Federal Water Pollution Control Act in 1948, the Congress declared that "water pollution has become a matter of grave concern in many areas and its damaging effects on the public health and national resources are a matter of definite Federal concern as a menace to national welfare. Abatement must be undertaken in order to control it."

The Public Health Service, as part of its responsibilities under this Act, is required to prepare or adopt, in cooperation with other Federal agencies, State and interstate water pollution control agencies, and municipalities and industries, comprehensive programs for the abatement of pollution.

This publication contains the "Comprehensive Water Pollution Control Program for the Minnesota River Basin" of the Iowa State Department of Health, the Minnesota State Department of Health and the South Dakota Committee on Water Pollution Control. The program is sound and gives full consideration to the several present uses and to the reasonably anticipated future uses of the waters of the basin. It provides an equitable balance in the pollution control requirements for various private and public groups concerned.

I am pleased, therefore, in my capacity as Surgeon General of the Public Health Service, to adopt the program developed by the Iowa State Department of Health, the Minnesota State Department of Health, and the South Dakota Committee on Water Pollution Control as a comprehensive program which fully meets the requirements of the Federal Water Pollution Control Act.

This program is based on beneficial water uses and related conditions that prevailed on January 1, 1954. Comprehensive programs for pollution control must necessarily be flexible. They must allow for growth, development, and changing conditions. Any significant changes affecting water quality, such as stream flow, water use, industrial development, population, etc., may require changes in the pollution control program.

Obviously the mere adoption of this program will not, in itself, reduce pollution or improve the usefulness of the waters of this basin. It does provide to the citizens of the area and to the city officials and industrial leaders, farmers, fishermen, conservationists, and others an objective plan based on good engineering practice and reflecting sound economics. It is a plan which the public can support, and must support, if progress is to be made in the abatement of pollution.

Certain additional considerations beyond the mere acceptance of a plan are essential to its successful execution. The citizens of the areas affected must see that sufficient resources are provided to the State water pollution control agencies concerned to enable them to make the technical investigations necessary to aid those responsible for constructing pollution abatement works.

We must recognize, too, that in order to be fully effective, the plans and programs of one State must be geared closely to those of adjoining States, since State boundaries are no barrier to pollution traveling in interstate streams. Above all, no program of this nature can progress beyond the report stage if its meaning and purpose are not made clear and understandable to the citizens of the area. In the final analysis they are the ones who will pay, directly or indirectly, for the pollution abatement works needed.

It is my hope that this program for the Minnesota River Basin will be carried through to completion as soon as possible so that the area may enjoy all the benefits that clean water can provide, in health and recreational opportunities for the people and in sound growth of industry and agriculture.

Leonard A. Scheele

Leonard A. Scheele
Surgeon General

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INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies, and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

This report, prepared in cooperation with the water pollution control agencies of Iowa, Minnesota, and South Dakota, sets forth the water pollution control program being followed by the respective States in the Minnesota River Basin. This program, which is based on data available as of January 1, 1954, was developed after a thorough consideration of the existing and potential uses of the water resources in the basin; the pollution entering the streams and the resulting damages; the benefits which may result from pollution prevention and abatement; and the prevention measures now in effect as well as those which are needed.

Agencies which cooperated in the preparation of this report included the Iowa State Department of Health, the Minnesota State Department of Health, and the South Dakota Committee on Water Pollution Control. Likewise, acknowledgment is made to the Corps of Engineers, Department of the Army; Soil Conservation Service, Department of Agriculture; Bureau of Census, Department of Commerce; Bureau of Mines, Fish and Wildlife Service, and Geological Survey, Department of Interior; and the Federal Power Commission for their review of the report and for the information obtained from their published reports.

COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM
for the
MINNESOTA RIVER BASIN

General Characteristics and Economic Development

The Minnesota River Basin consists of a watershed area of about 16,920 square miles situated in southwestern Minnesota with about 10 percent located in South Dakota and 2 percent in Iowa. The principal tributaries are the Little Minnesota, Chippewa, Cottonwood, Redwood, Lac Qui Parle, Pomme de Terre, and Yellow Medicine Rivers.

Low rolling hills and outwash plains predominate in the west and southwest; steep hills and lake-dotted moraines abound in the east and northeast; and a tableland, several hundred feet above the river valley, forms the southern portion of the basin. The Minnesota River has a rather flat slope - about 0.84 foot per mile - except in the headwater area where the stream gradient is quite steep. The tributary streams have steep gradients until they reach the Minnesota River Valley, where they level off to join the Minnesota.

Flow characteristics of the rivers of the basin are very erratic, with damaging floods occurring as often as once in three years. During certain periods of the year there is practically no flow in most of the streams; many of the tributaries are completely dry during the summer months. Critical stream flows develop in early fall during dry weather and again in the winter when ice cover retards or completely stops the flow.

The climate of the basin is a short-summer, semi-arid, continental type with monthly mean temperatures varying from 6° F. to 72° F. Average annual precipitation ranges from 22 inches in the north to 29 inches in the south with about two-thirds of the moisture falling during the growing season which averages about 140 days.

The basin is predominantly rural with nearly two-thirds of the total area classed as improved farmland. Corn and small grain production is the principal agriculture activity, but dairy and livestock farming are also extensively practiced. The basin's industrial development is closely associated with those industries that depend upon agriculture for their raw materials. The basin has no major single industrial center; its industries are dispersed throughout the area, being located close to their source of raw materials.

The 1950 population of the basin was 469,000, with 75 percent living in rural areas and small communities. The largest city in the basin, Mankato, Minnesota, had a population of 18,809 and the second largest, New Ulm, Minnesota, a population of 9,348. Twenty-one other cities had populations of 2,500 or over, four of which exceeded 5,000.

Water Use and Water Quality Objectives

The basin's waters are used for municipal, domestic, and industrial supplies; stockwatering; fish and wildlife propagation; recreation; and to a minor extent for navigation and water power.

Two communities use surface water as the source of their municipal supply. The quality of finished water for municipal supply depends, to a considerable degree, upon the quality of the raw water. Therefore, source water quality objectives are among the factors considered in determining the treatment requirements for pollution sources upstream.

In determining the suitability of water sources for municipal and domestic supplies, State health and water pollution control officials use Public Health Bulletin 296, "Manual of Recommended Water Sanitation Practice," or established State standards, as a guide.

Surface waters of the basin are used extensively for watering livestock, one of the basin's principal sources of income. Water quality objectives for this use have not been precisely defined, but authorities consider the elimination of such pollution as floating and settleable solids and high bacterial concentrations desirable.

Several of the industries use the basin's surface waters as their source of supply. Water quality requirements for these industrial supplies vary, and no specific criteria can be adopted as each case must be considered separately in light of the specific needs of the industry under consideration. Of general concern, however, are the organic and biological constituents, toxic and taste or odor producing substances, and properties of corrosion, encrustation, and slime formation.

Streams and lakes receive heavy recreational use, including sport fishing, swimming, camping and boating. There are several recreational developments and State parks in the basin where camping, swimming, boating and other recreational facilities are available. Commercial fishing is an important use of the larger streams and lakes; and the waters, particularly those in the lake regions of the basin, also serve as wildlife habitats. The general criteria advocated by the U. S. Fish and Wildlife Service calling for a balanced aquatic habitat and limiting concentrations of pollutional substances are used by authorities in this basin for fishing waters.

Contamination of bathing water by sewage, especially that of recent origin, is objectionable, and water for bathing and other recreational use should be free of floating solids, sludge banks, odors, and discoloration. Health officials discourage the development of bathing facilities in waters known to be polluted with sewage. Although quality objectives for water used for non-swimming recreation do not set forth as high a bacteriological criterion, the same basic fundamentals are used by the States in their programs concerning those uses.

Navigation is limited to the lower portion of the Minnesota River where a nine-foot channel is maintained from its mouth to Savage, Minnesota, and a three-foot channel upstream to Shakopee, Minnesota.

Production of water power is not a major use, but there are some water power developments in the basin. Quite importantly, the basin's waters also serve as final outlets for the wastes of its communities and industries.

Sources and Effect of Pollution

There are 112 sewered communities and 54 separate industrial waste outlets in the basin which discharge a pollution load to the watercourses that has a combined population equivalent of at least 300,000.

Approximately 188,000 of the basin's 1950 population reside in the communities that have sewerage systems, and 155,000 are served by municipal sewers. A large portion of the wastes discharged from municipal sewers in this basin is contributed by industries connected to the public sewer systems. This is indicated by the fact that 20 communities which serve a combined population of 50,000 discharge wastes with a population equivalent of 71,400, 40 percent greater than the population served, even though five of these communities provide treatment facilities for their wastes. The amount of pollution discharged by the other 91 sewered communities has not been determined.

Industrial wastes with a combined population equivalent of 133,780 are discharged through separate outlets by 10 industries, two of which account for 130,000 of this amount. The limited personnel and facilities of the pollution control agencies have not permitted an accurate evaluation of the significance of the other 44 separate outlets known to exist in the basin. However, if any of these outlets are causing a nuisance or water damage, it is believed to be local in extent and not to constitute a major pollution problem at this time.

Thirty-seven sewered communities, serving a combined population of 55,000, provide no treatment facilities for their wastes, while 27 of the 75 existing sewage treatment plants lack sufficient capacity or facilities to adequately handle the present load. Fifteen of the existing industrial waste treatment works do not have adequate facilities, and 12 other industries for which data are available are known to discharge wastes without treatment.

The quality of the water used for livestock watering has been reported damaged to varying degrees in the streams below 102 waste outlets in the basin. In many cases, this damage is localized and affects only a very short stretch of water, while in many other cases the damage occurs only during short periods of the year when the stream is in critical flow stages.

Sport and commercial fishing are damaged in many areas throughout the basin as a result of the discharge of untreated or inadequately treated sewage and industrial waste. Wildlife habitat has also been reported damaged, as has water used for swimming, boating and camping.

The discharge of municipal sewage is responsible for pollution to the extent that normal water uses are impaired in varying degrees below 60 communities and institutions. At 9 other locations the pollution can be attributed specifically to industrial wastes, while industries and municipalities share the responsibility in 18 instances. Nuisance conditions are reported to exist below 34 communities.

Much of the turbidity, and many of the physical problems due to pollution, originate from the processes of erosion. The sediments produced by erosion are a form of pollution which can impair many of the water uses, such as water supply for domestic and industrial purposes, stockwatering, fish and wildlife propagation, and swimming.

This inorganic pollution is more in evidence during high waters as contrasted to organic pollution which is usually more noticeable during low flow conditions.

Progress in Pollution Abatement

The water pollution control agencies of the States are actively working on the pollution control programs of this basin and are using existing authority in an effective manner. They work cooperatively with municipalities and industries in solving pollution problems and enforcing existing statutes. Municipal cooperation with their pollution control programs has resulted in sewage treatment being provided by 75 of the basin's 112 communities that have sewage systems. About 65 percent of the sewered population is now being served by these sewage treatment plants. Thirty-two communities are working toward the solution of their pollution problems. Twenty-nine of the industries have provided treatment, and seven are actively engaged in providing treatment or improving the treatment now provided. The extent of the pollution control activity in the basin is indicated by the fact that 30 communities and five industries have waste treatment plant plans approved for construction or under preparation, and two municipalities and two industries have waste treatment facilities under construction.

The water pollution control laws of the States in the basin are adequate to abate pollution and to prevent or control new or increased sources of pollution. The State water pollution control programs have been successful in this basin, but in order for the State agencies to continue their effective and active programs, they must be furnished with adequate appropriations to enable them to attract and hold sufficient qualified personnel to carry on and expand their activities.

A start has been made toward the abatement of inorganic pollution by the landowners throughout the watershed. Through the adoption of conservation practices on the watershed lands, erosion is decreased and less sediment is produced. Over fifty percent of the watershed is in organized Soil Conservation Districts. These districts have the assistance of the Soil Conservation Service in developing sound programs of land use which will have an increasing effect upon the control of sediment production and accompanying pollution.

Pollution Prevention Measures Required

Excellent progress has been made on the control of pollution in recent years, but there are still a number of projects that must be constructed before adequate control or prevention is realized. Analysis of the available data which show stream characteristics, the amount of wastes discharged to the watercourses, present water quality in the streams, and existing water uses in relation to generally accepted water quality objectives, has enabled the determination of pollution abatement requirements for the major sources of pollution in the basin. To meet these requirements, 37 new sewage treatment plants should be constructed for systems now without treatment and serving 55,200 people, as well as nine new sewage treatment plants to replace inadequate existing plants that are now serving a connected population of 11,800. Enlargements or additions are needed at 18 existing plants, which serve 28,900 people, to enable them to produce a satisfactory effluent. To adequately treat the industrial wastes and prevent pollution damage, 14 new waste treatment plants should be constructed and nine existing treatment works should be enlarged or provided with additional facilities.

Additional technical data will be required to determine the total pollution load from all municipalities and industries. However, the data now available are sufficient to permit continuation of the comprehensive programs for the elimination of many of the pollution problems that now exist.

Water Pollution Control Program

The needed corrective measures discussed herein and listed below are based upon studies and investigations made by the responsible water pollution control agencies in the States concerned, and are part of the pollution abatement programs now being carried out by these agencies. The pollution prevention and control measures recommended are intended to restore, preserve, and protect all reasonable water uses including those now existing, and those which may materialize in the immediate foreseeable future. These remedial measures were arrived at only after a thorough consideration of all water uses in the basin and are considered to be reasonable and adequate.

The corrective measures listed below are flexible and are intended to reflect the needs for the present situation as it now exists; however, changes in stream characteristics, pollutional load, or water uses may require revisions in the indicated required treatment at some future date.

The essential elements of the program as developed by the States concerned consist of the following:

1. Provide the following improvements:

Name and Location	Improvements Needed	Remarks
Amboy, Minn.	Additions to existing treatment plant	
Arlington, Minn.	Enlargement of existing treatment plant	
Big Stone Canning Co.	Enlargement of existing treatment plant	
Barrett, Minn.		
Barrett Coop. Locker Assn.	Additions to existing treatment plant	
Belle Plaine, Minn.	New treatment plant	
Minn. Valley Coop. Cry.	New treatment plant	Active planning
Benson, Minn.	Additions to existing treatment plant	Plans approved
Swift Falls Coop. Cry.	New treatment plant	
Bird Island, Minn.	New treatment plant	Active planning
Blue Earth, Minn.	New treatment plant	
Bricelyn, Minn.	New treatment plant	
Browns Valley, Minn.	Enlargement of existing treatment plant	Active planning
Butterfield, Minn.	Additions to existing treatment plant	

Name and Location	Improvements Needed	Remarks
Carver, Minn.		
Minn. Cave Cheese Co.	New treatment plant	
Chaska, Minn.	New treatment plant	
Mudcura Sanitarium	New treatment plant	
Am. Crystal Sugar Co.	New treatment plant	
Clinton, Minn.	Enlargement of existing treatment plant	
Cyrus, Minn.	Enlargement of existing treatment plant	
Dawson, Minn.	Enlargement of existing treatment plant	
De Graff, Minn.	New treatment plant	Plans approved
Easton, Minn.	New treatment plant	
Elmore, Minn.	New treatment plant	
Fairmont, Minn.	Enlargement of existing treatment plant	Plans approved
Fairmont Canning Co.	Enlargement of existing treatment plant	Active planning
Franklin, Minn.	New treatment plant	Plans approved
Garden City, Minn.	Construction of sewers and treatment plant	Under construction
Gaylord, Minn.	Replacement of existing treatment plant	Active planning
Gibbon, Minn.		
Gibbon Coop. Cry.	New treatment plant	
Good Thunder, Minn.	New treatment plant	
Granada, Minn.	New treatment plant	Active planning
Hanley Falls, Minn.	New treatment plant	
Henderson, Minn.	New treatment plant	Plans approved
Hendricks, Minn.	Enlargement of existing treatment plant	
Ivanhoe, Minn.	New treatment plant	Plans approved
Janesville, Minn.	Replacement of existing treatment plant	Plans approved
Janesville Cry. Assn.	New treatment plant	

Name and Location	Improvements Needed	Remarks
Jordan, Minn.	Additions to existing treatment plant	
Kerkhoven, Minn.	Construction of sewers and treatment plant	Active planning
Lafayette, Minn.	New treatment plant	
Lamberton, Minn.	New treatment plant	Active planning
Le Center, Minn.	Replacement of existing treatment plant	Plans approved
Le Sueur, Minn.	New treatment plant	
Green Giant Co.	Enlargement of existing treatment plant	
Lewisville, Minn.	New treatment plant	Plans approved
Lowry, Minn.	New treatment plant	
Madelia, Minn.	New treatment plant	Active planning
Mankato, Minn.	New treatment plant	Plans approved
Mapleton, Minn.	Enlargement of existing treatment plant	
Marshall, Minn.	Enlargement of existing treatment plant	Plans approved
Montevideo, Minn.		
Montevideo Coop. Canning Assn.	New treatment plant	Active planning
Morgan, Minn.	Construction of sewers and treatment plant	Plans approved
Mountain Lake, Minn.	Additions to existing treatment plant	Plans approved
Mudbaden, Minn. Sanatorium	New treatment plant	
New Prague, Minn.	Replacement of existing treatment plants	
National Milling Co.	New treatment plant	
New Ulm, Minn.		
John Hauenstein Brewery	New treatment plant	
North Mankato, Minn.	New treatment plant	
Olivia, Minn.	Replacement of existing treatment plant	Plans approved
Ortonville, Minn.	Enlargement of existing treatment plant	Plans approved
Big Stone Canning Co.	Additions to existing treatment plant	Plans approved

Name and Location	Improvements Needed	Remarks
Prior Lake, Minn.	Construction of sewers and treatment plant	Active planning
Renville, Minn.	Enlargement of existing treatment plant	Plans approved
Russell, Minn.	New treatment plant	
St. Bonifacius, Minn.	Construction of sewers and treatment plant	Active planning
St. Peter, Minn.	New treatment plant	Active planning
State Hospital	New treatment plant	Active planning
Sanborn, Minn.	New treatment plant	
Savage, Minn.		
Minn. Masonic Home	New treatment plant	
Shakopee, Minn.	New treatment plant	
Reformatory for Women	New treatment plant	
Cargill, Inc.	New treatment plant	Under construction
Sisseton, S. Dakota	Replacement of existing treatment plant	Plans approved
Sleepy Eye, Minn.	Enlargement of existing treatment plant	Active planning
Starbuck, Minn.	Replacement of existing treatment plant	Active planning
Storden, Minn.	Construction of sewers and treatment plant	Plans approved
Swift Falls, Minn.		
Swift Falls Coop. Cry.	New treatment plant	
Truman, Minn.	New treatment plant	Plans approved
Tyler, Minn.	New treatment plant	Plans approved
Walnut Grove, Minn.	Replacement of existing treatment plant	Plans approved
Waseca, Minn.	New treatment plant	Under construction
Welcome, Minn.	New treatment plant	
Wells, Minn.	Replacement of existing treatment plant	Under construction
California Packing Co.	Additions to existing treatment plant	Plans approved
Westbrook, Minn.	Additions to existing treatment plant	

Name and Location	Improvement Needed	Remarks
Winnebago, Minn.	New treatment plant	Under construction
Winthrop, Minn.	New treatment plant	Under construction
Green Giant Co.	New treatment plant	

2. Operate all existing and future waste treatment works at a uniformly efficient and high level in order to obtain maximum benefits from these facilities and permit their most effective utilization.

3. Continue the policy of requiring adequate treatment of wastes both from new sources and from expanded use of existing facilities, in order to preclude new pollution problems.

PHYSICAL DESCRIPTION

The Minnesota River Basin is situated in southwestern Minnesota with a small portion extending into northeastern South Dakota and a very small area in northcentral Iowa. The total basin area is about 16,920 square miles with 88 percent in Minnesota, 1,640 square miles in South Dakota, and only 370 square miles of the extreme southern tip in Iowa.

The Little Minnesota River rises on the eastern slope of the Dakota foothills, in South Dakota, about 10 miles south of the North Dakota line and about 30 miles west of the Minnesota border. It flows in a southeasterly direction to the Minnesota-South Dakota boundary and then through Big Stone Lake which forms about 30 miles of the boundary between the two States. The Minnesota River rises in Big Stone Lake and flows in a southeasterly direction through Minnesota for 225 miles to Mankato, Minnesota. At Mankato, the river makes a sharp turn and flows northeast 106 miles to enter the Mississippi River just south of the dividing line between Minneapolis and St. Paul. The principal tributary streams originating south of the river are the Whetstone, Yellowbank, Lac Qui Parle, Yellow Medicine, Redwood, Cottonwood, and Blue Earth Rivers. The Little Minnesota, Pomme de Terre and Chippewa Rivers are the largest streams which enter from the north.

Several aspects of glaciation are reflected in the general topography of the basin. Low rolling hills and outwash plains shape the surface in the west and southwest, while steep hills and lake-dotted moraines abound in the east and northeast. The southern portion of the basin consists of a tableland 20 to 30 miles wide, which lies several hundred feet above the river valley. Surface elevations throughout the basin range from 700 to 1,900 feet above sea level. The region is generally covered with a fertile blue till, a mixture of sand, clay, and gravel of glacial origin. The tableland is capped with porous deposits of sand and gravel which are outcrops of the water-bearing strata that supply the wells and springs of the basin.

The Minnesota River follows a trough some 200 feet deep and one-half to two miles wide which was eroded by one of the huge rivers draining the lakes formed by the retreating ice during the last glacial period. The Minnesota River has a rather flat slope of about 0.84 foot per mile. The tributary streams have steep slopes except in the Minnesota River Valley where they flatten out as they join the Minnesota.

Climatically the basin is located in the transition zone between the humid and semi-arid continental short summer types. The average annual precipitation in the basin varies from 29 inches in the southern portion to 22 inches in the north with about two-thirds of it falling during the growing season. About three inches of the annual precipitation occurs as snow which remains throughout the winter. The average January temperature varies from 6° F. in the northern section of the basin to 14° F. in the southern portion. Corresponding July temperatures are 70° F. and 72° F. The first killing frosts of the fall occur about September 25 in the northwest, and October 5 in the south, while the dates of the last killing frosts of the spring range from May 20 in the northwest to May 5 in the south.

The Minnesota River and its tributaries have very erratic flow characteristics. The large area of the basin, the steep slopes of the tributaries, the gentle slope of the Minnesota, and the small channel capacity, all combine to cause severe floods in the Minnesota Valley. Damaging floods have occurred as often as once in three years; yet at certain periods of the year there is practically no flow in most of the basin's streams and many of the smaller tributaries are completely dry during the summer months except for occasional short periods of storm water runoff. An example of the wide fluctuations in flow is found at the gaging station on the Minnesota River at Montevideo, Minnesota. The 41-year average discharge at this station from 1909 to 1950 is 526 cubic feet per second (cfs), but the maximum discharge recorded was 22,000 cfs in 1919 and no flow occurred for several days in 1933, 1934, and 1936. Flow characteristics at other gaging stations on the main stem and on the tributaries are shown in the following table:

STREAM FLOW DATA AT VARIOUS LOCATIONS IN THE MINNESOTA RIVER BASIN

River and Gaging Station	Drainage area in sq. mi.	Years of Record	River Discharge in Cubic Feet Per Sec.			
			Average	Maximum	Minimum	Average During Driest Month
Little Minnesota River Peever, S. Dak.	447	11	58	3,660	0	0
Minnesota River Ortonville, Minn.	1,160	12	110	1,660	0	0.20
Minnesota River Montevideo, Minn.	6,180	41	526	22,000	0	6.39
Minnesota River Judson, Minn.	11,200	12	1,518	16,100	17	31.5
Minnesota River Mankato, Minn.	14,900	47	2,331	43,800	26	58.4
Minnesota River Carver, Minn.	16,200	16	2,742	32,600	85	111.0
Whetstone River Big Stone City, S. Dak.	389	15	51	5,500	0	0.31
Yellowbank River Odessa, Minn.	398	11	56	5,090	0	0.25
Pomme de Terre River Appleton, Minn.	885	15	79	3,140	0	0
Lac Qui Parle River Lac Qui Parle, Minn.	983	19	95	7,490	0	0
Chippewa River Milan, Minn.	1,870	13	183	5,170	0	0
Yellow Medicine River Granite Falls, Minn.	653	13	80	3,510	0	0.90
Redwood River Redwood Falls, Minn.	697	15	85	2,800	0	0.19
Cottonwood River New Ulm, Minn.	1,280	16	242	13,800	0.6	1.47

Minimum or critical flows in this basin usually occur in the fall or early winter. Available records indicate that five percent of the daily average flows will be less than 2 cfs on all of the tributaries and on the main stem above Montevideo, Minnesota. A minimum 10-day average flow of less than 2 cfs can be expected once in five years or oftener on these same streams. The many impoundments in the basin, principally natural lakes and swamps but including some hydroelectric projects, tend to retain a portion of the spring runoff. This stored water augments the flow during the dry summer months and shifts the critical low flow period from late summer into fall. Ice generally has a sufficient effect on runoff to retard stream flow and develop a winter critical low flow period from December to February.

ECONOMIC DEVELOPMENT

The 1950 population of the Minnesota River Basin is about two percent greater than the 1940 population and is estimated to be about 469,000. The majority of the people reside in Minnesota, with only two percent in Iowa and five percent in South Dakota. The basin is basically rural with over 356,000 of the people living in rural areas and small communities. The 1950 census listed 220 communities in the basin, of which 118 have populations under 500, 43 populations between 500 and 1,000, and 36 populations between 1,000 and 2,500. The total urban population of the basin is 112,300, with 56,800 living in 17 communities ranging in size from 2,500 to 5,000 and 55,500 living in the six cities with populations exceeding 5,000. Mankato, Minnesota, with 18,809 people, is the basin's largest city, and New Ulm, Minnesota, with 9,348 ranks second. The average population concentration is 27 persons per square mile; densities vary from as low as 10 persons per square mile in Marshall County, South Dakota, to 98 persons per square mile in the basin's portion of Hennepin County, Minnesota.

The average effective buying income for the basin was approximately $1,052 per person in 1950 and ranged from $668 in Deuel County, South Dakota, to $1,625 in Hennepin County, Minnesota. The national average for the same year was $1,311.

Well over half of the basin's gainfully employed persons depended upon agriculture for their principal source of income in 1947. Nearly two-thirds of the total area is classed as improved farmland with corn, peas, and small grains the principal farm crops. Dairy and livestock farming are also widely practiced and of considerable importance.

The principal industrial developments of the basin are those that depend on agriculture for raw materials. The industries include canneries, cheese factories, dry milk and milk condensing plants, creameries, food locker plants, rendering plants, breweries, a beet sugar refinery, produce houses, grain mills and a malting plant. There is also some granite industry in the western portion of the basin along the Minnesota River.

USES OF WATER RESOURCES

Important uses of the basin's waters include municipal, domestic, and livestock supplies; ice harvesting; sport and commercial fishing; wildlife; bathing and other recreation; hydroelectric power; and navigation.

One hundred and sixty communities have water supplies which serve a total estimated population of 164,000. Fairmont and Granite Falls, Minnesota, serving a combined population of 9,390, are the only communities in the basin which use surface waters as the source of their public water supplies. Three communities use springs as their supply source, while all of the other communities rely upon wells.

Source water quality objectives are among the factors considered in determining treatment requirements for pollution sources upstream of municipal and domestic supplies. In appraising the suitability of water sources for such supplies, State health and water pollution control officials of the basin use Public Health Bulletin 296, "Manual of Recommended Water Sanitation Practice," or established State standards, as a guide.

The outstanding water use in this basin is for livestock watering. Dairy farming is extensively practiced throughout the basin, and the majority of the farmers rely on the streams and lakes as the source of water for their stock. Water quality objectives for stock watering have not been precisely defined, but elimination of such pollution as floating and settleable solids and high bacteria concentrations is desirable to provide water quality satisfactory for stock use.

Several industries in the Minnesota River Basin use the surface waters as their source of supply. Because of the diversity of needs, quality requirements for industrial water supplies vary widely, and no specific criteria have been adopted as each industry must be considered separately. Of general concern, however, are the organic and biological constituents, toxic and taste or odor producing substances, and properties of corrosion, encrustation, and slime formation of the available waters.

The streams and lakes are used extensively for recreational activities, especially in the northern portion of the basin. Fishing, swimming, and boating are all important uses. Game fish are plentiful in the lakes and many of the streams, particularly in those portions of the larger streams which do not receive untreated sewage or industrial wastes. There is some commercial fishing activity on the Minnesota, Little Minnesota, Lac Qui Parle and Chippewa Rivers, and also on Big Stone Lake. Because of the erratic flow characteristics of many of the smaller streams, they are of limited use for those forms of recreation employing the water directly, such as fishing, swimming and boating. There are 17 State parks within the basin, located, in general, beside streams and lakes where camping, swimming, boating and other recreational facilities have been developed. The basin also contains a portion of the Buffalo Slough National Game and Wildlife Refuge.

Hunting is popular and good over most of the basin and, while not a direct water use, it depends upon the game attracted to the area by the water available for its use and convenience. Hunting camps and lodges are generally located where an ample supply of good quality water is available for domestic use as well as for aesthetic enjoyment.

Contamination of bathing water by sewage, especially that of recent origin, is objectionable, and water for bathing and other recreational usage should be free of floating solids, sludge banks, odors and discoloration. Sanitary surveys and the bacteriological quality of the water are employed in the administration of pollution control programs as related to bathing waters of this basin. Health officials discourage the development of bathing facilities in waters known to be polluted with sewage. Although quality objectives for water used for non-swimming recreation do not set forth as high a bacteriological criterion, the same basic fundamentals are used by the States in their programs.

The U. S. Fish and Wildlife Service has set forth certain water quality criteria for freshwater fish which are used by the States in their water pollution control programs. These

MINNESOTA RIVER BASIN

EXISTING PRIMARY WATER USES

U.S. DEPARTMENT OF
HEALTH EDUCATION AND WELFARE
Public Health Service

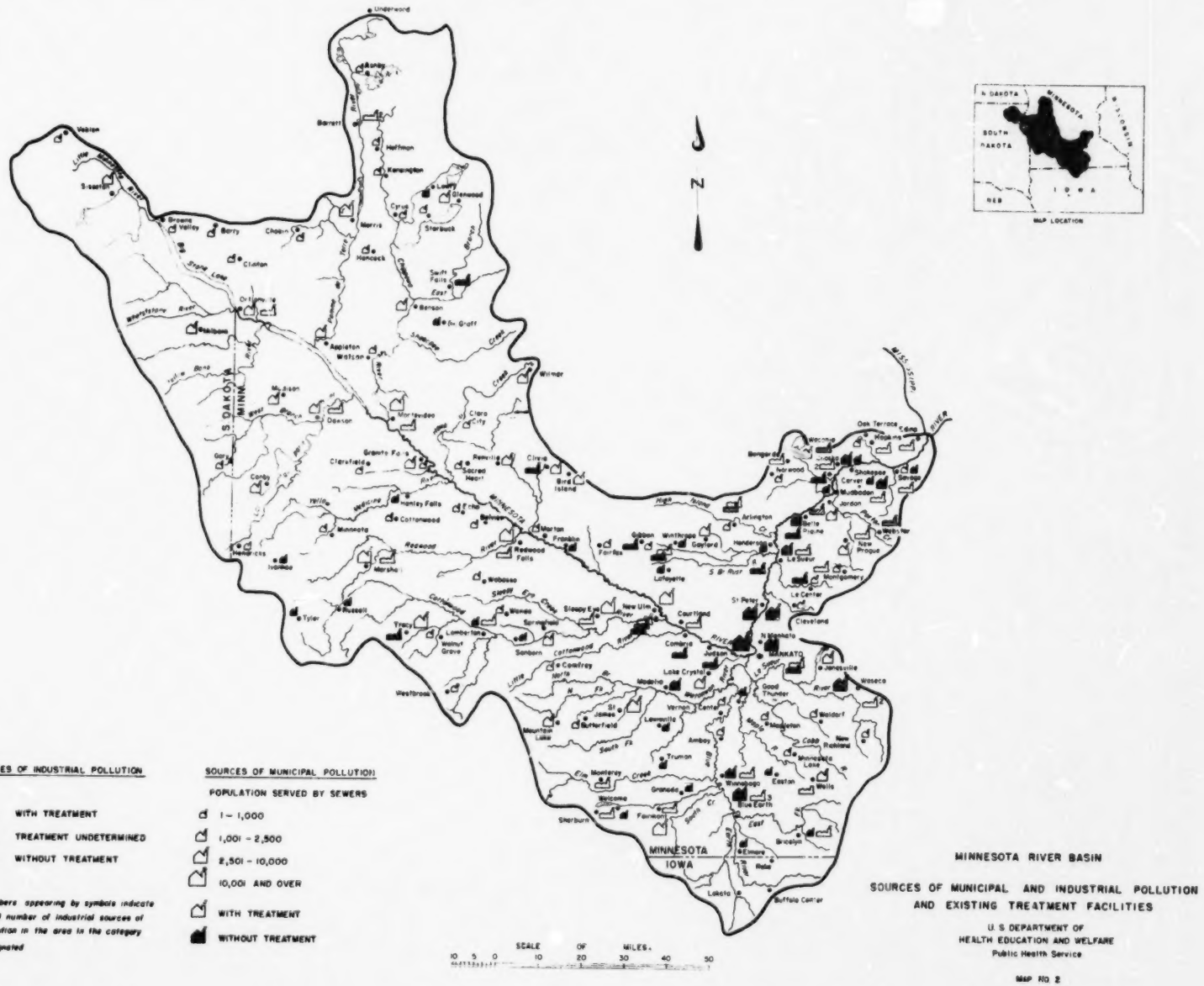
MAP NO. 1

criteria call for a balanced aquatic biota and the elimination of sludge beds, silt sedimentation, and other deposits which tend to blanket the bottom and destroy the biological life.

The development of water power in this basin has been limited by the erratic and low stream flows and the absence of suitable storage sites. Power developments now exist at Rapidan on the Blue Earth River, at Redwood Falls on the Redwood River, and at Minnesota Falls and Granite Falls on the Minnesota River. The Corps of Engineers has a flood control project on the Minnesota River at Marsh and Lac Qui Parle Lakes which provides 94,500 acre feet of flood storage and 58,500 acre feet for conservation purposes. The National Resources Committee recommended in its 1936 and 1937 reports that consideration be given to the development of incidental water power in connection with possible reservoirs for flood control or other purposes in view of the lack of known coal, oil and gas deposits in the area.

The Minnesota River formerly carried freight traffic and is still considered navigable for small craft from its mouth up to Mankato during wet seasons. The U. S. Army Engineers maintain a four-foot channel to Shakopee. Private interests have developed and are maintaining a nine-foot channel to Port Cargill.

All of these water uses are considered essential for the improvement of the economic condition, health and welfare of the people of the basin, and conservation of the water resources is necessary for the continued development of the area. Waste discharged to the watercourses must be treated as a conservation measure to achieve the pertinent water quality objectives and to maintain the waters in a suitable condition for legitimate water uses.


N
S. DAKOTA
MINN.
MINNESOTA
IOWA
MINNESOTA RIVER BASIN
SOURCES OF MUNICIPAL AND INDUSTRIAL POLLUTION
AND EXISTING TREATMENT FACILITIES
U. S. DEPARTMENT OF
HEALTH EDUCATION AND WELFARE
Public Health Service
MAP NO. 2
SOURCES OF INDUSTRIAL POLLUTION
WITH TREATMENT
TREATMENT UNDETERMINED
WITHOUT TREATMENT
NOTE
Numbers appearing by symbols indicate total number of industrial sources of pollution in the area in the category designated
SOURCES OF MUNICIPAL POLLUTION
POPULATION SERVED BY SEWERS
1 – 1,000
1,001 – 2,500
2,501 – 10,000
10,001 AND OVER
WITH TREATMENT
WITHOUT TREATMENT
SCALE OF MILES
10 5 0 10 20 30 40 50
MAP LOCATION

POLLUTION DISCHARGED TO SURFACE WATERS

The major pollution problem of this basin stems from the large number of widely scattered small sources consisting of 112 sewered communities and 54 industries. Although most of the sources of pollution in the basin are small, many of them are important in the pollution control program because they discharge into streams that have very little flow at times.

Approximately 40 percent of the total 1950 population live in communities which have sewerage systems and 80 percent of these people are served by the municipal sewers. A large portion of the waste discharged from the municipal sewer outlets is contributed by industries connected to the public sewer systems. This is indicated in Table A, which shows that 20 municipalities discharge wastes with a population equivalent of 71,400. This is 40 percent greater than the 50,000 people served, even though five of the communities provide treatment facilities for their wastes.

TABLE A
SEWERED MUNICIPALITIES*

Municipalities	Number	Population Served by Sewerage System	Amount of Pollution Discharged to Watercourse (in terms of equivalent number of people)
Having data on pollution load discharged to watercourse	20	49,680	71,395
Having population data available (data on pollution load to watercourse incomplete or not available)	92	105,307	Not applicable
Total	112	154,987	xxx

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers; sanitary sewage wastes discharged by industry directly to watercourses, and industrial wastes discharged into municipal sewerage systems.

Seventy-five communities, serving a combined population of nearly 100,000, provide sewage treatment facilities for their wastes. However, the pollution control secured by these plants has not been entirely satisfactory as some of them are not producing the degree of treatment for which they were designed. Because of age, or for some other reason, 27 of these plants no longer have adequate capacity to handle the load imposed on them and cannot reduce the pollution characteristics of the waste to the extent required by existing downstream water uses. Operation at 33 of the 74 plants is not considered to be entirely satisfactory, and pollution is not reduced as much as it could be if existing facilities were used efficiently. Thirty-seven municipalities, serving a combined population of 55,200 or about one-third of the total sewered population, discharge wastes to the streams without any treatment.

Fifty-four industries in this basin do not discharge to municipal systems, but have separate outlets. All but one of these industries produce organic wastes. One plant produces both organic and inorganic waste. The waste discharged by ten of these industries is equivalent to sewage from a population of nearly 134,000 people.

The major sources of industrial pollution have been determined, and their effects on the waters are well understood. Detailed information on the numerous smaller sources has not been secured, since an accurate evaluation of their significance would require a separate investigation to determine the degree of pollution in each case. While these sources are known to exist, any nuisance or water damage which they may cause has not been of sufficient magnitude to bring them to the attention of pollution control authorities.

DAMAGES TO WATER RESOURCES FROM POLLUTION

Pollution has caused damage to legitimate water uses in certain areas. The amount of damage varies with the degree of pollution; it depends upon the extent to which the existing water uses are affected, and potential water uses are held in abeyance, by the unsatisfactory water quality. Water use damages result from bacterial pollution, deoxygenation by organic pollution, toxicity, increased hardness, chloride content, or from the presence of color, odor or taste producing substances. Where nuisance conditions exist, all existing water uses along the stream for some distance below the source of pollution are damaged and additional uses are prohibited by the excessive pollution load with which the stream is burdened.

As livestock watering is the most widespread water use in this basin, any water damage which affects this use is of economic importance to its people. This use has been reported damaged to varying degrees in the streams below 102 waste outlets in the basin. In many cases, this damage is localized and does not extend very far downstream from the waste outlet, and in many other cases the damage occurs for only a short time of the year when the stream is in critical flow stages. However, the fact that the pollution damage does not extend very far downstream is of little help to the farmer who must depend upon the polluted stretch of stream for water.

The discharge of municipal sewage is responsible for pollution to the extent that normal water uses are impaired to varying degrees below 60 communities and institutions. At nine other locations the pollution can be attributed specifically to industrial wastes, while industries and municipalities share the responsibility in 18 instances. Nuisance conditions are reported to exist below 34 communities.

Sport and commercial fishing are damaged in many areas throughout the basin as a result of the discharge of untreated or inadequately treated sewage and industrial wastes. Streams that furnish a habitat for wild life have also been reported damaged. Recreation, such as swimming, boating and camping, has been damaged by organic pollution which resulted in high bacterial concentrations or odor nuisances in the waters. During critical periods, the stream flows in most of this basin are so low that untreated or inadequately treated wastes and sewage have a deleterious effect on all forms of recreation, including those using the water directly or indirectly. This damage results in loss to water users in the form of increased time and expenditures needed for traveling to unpolluted waters where recreation can be enjoyed. In cases where time and finances do not permit the longer travel distances made necessary by pollution of nearby waters, the complete loss of the recreational opportunity afforded by fishing or water sports is of considerable significance.

Possible damage to property values should not be overlooked when assessing the cost of pollution damage. Condition of the available water is an important factor when locating on or near streams and lakes, or when developing waterfront property. There is little doubt that property values have suffered some loss due to pollution in those areas of the basin where nuisance conditions exist, but no data are available as to the extent of such damage.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

Pollution abatement activities cost money, but the cost is generally well justified considering the long-range benefits which accrue. Preserving and improving the surface waters for agricultural use is of considerable benefit to the economy of the entire basin. A good quality water supply that is palatable and free of disease organisms is essential for healthy animals and profitable livestock farming. The benefits resulting from the elimination of pollution damage to provide clean water for livestock in an area so predominantly agricultural are self-evident.

Preserving and improving the surface waters as sources of public and industrial water supplies is of specific benefit to the municipality and industry whose water supply is now being damaged. Monetary benefits will result from the production of safe potable water for domestic use and acceptable process water for industry at minimum treatment costs.

Fishing in most of the area is good, at present, in those portions of the streams that are free of pollution; therefore, it seems logical to expect that fishing facilities will increase if adequate treatment is provided for the wastes now discharged into the polluted sections of the streams. Swimming and boating and camping areas will increase in number with adequate waste treatment. Sites now being used will improve in value with the elimination of odor nuisances and the public health hazards associated with pollution.

Pollution control will assure increased and continued benefits from recreational use of the basin's waters. Abatement of pollution will aid in promoting more extensive development of these resources, and prevention of future pollution will assure continued use. Wider development of the water resources for recreational use will reduce travel distances from population centers to desirable fishing, recreational and boating sites and will result in reduced costs and increased recreation time. This benefits all of the basin's people, but it is especially beneficial to those residing in the areas where lakes are not available and streams with very small flows must be used.

This basin's water resources have not suffered widespread damage but they have reached a stage where correction of acute local pollution is desirable. Abatement of existing pollution will restore the damaged water uses and the prevention of additional pollution will preserve the water for future uses. The basin's water resources are vital to its continued prosperity. Expenditures made to preserve them will be a sound investment.

POLLUTION PREVENTION MEASURES IN EFFECT

State water pollution control agencies have been actively engaged for many years in solving the pollution problems of this basin. Progress has been steady since the first plant was constructed by Milbank, South Dakota, in 1905. The success of the pollution abatement programs of the States is evidenced by the 75 municipal sewage treatment plants now operating in the basin. These plants serve 75 communities and treat the wastes from 99,767 people, two-thirds of the total sewered population of the basin.

TABLE B
EXISTING TREATMENT FACILITIES
MUNICIPAL

Degree of Treatment Provided	Number of		Population Served
	Municipalities*	Plants	
Primary	32	32	31,477
Secondary	43	43	68,290
No Treatment	37	--	55,220

*Includes incorporated and unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers; sanitary sewage discharged by industry directly to watercourse and industrial wastes discharged into municipal sewerage systems.

Primary treatment is provided by 32 municipalities for about 31,000 people while secondary treatment facilities are provided for the wastes from 68,000 people by 43 communities.

A classification of the industries with separate outlets shows that the Food Industry predominates in this basin. There are 19 plants processing milk or milk products, 15 canneries and nine miscellaneous food establishments, such as food lockers, slaughterhouses and sugar production. Other industries present include seven rendering plants and two breweries.

Thirty-six of the 54 industries are known to provide treatment for their wastes, while twelve do not. Facilities available at six of the industries have not been determined.

Forty-five of the municipal sewage treatment plants which serve a combined population of about 56,000 have adequate capacity to satisfactorily treat the wastes they receive, and 19 of the industrial waste treatment plants have sufficient capacity to handle the wastes produced by the industry served.

TABLE C
ADEQUACY OF EXISTING TREATMENT FACILITIES

Existing Treatment Facilities	Number	Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	75	45	27	3	37	33	5
Industrial	36	19	15	2	25	8	3

As shown in the above table, 27 municipal and 15 industrial waste treatment plants do not have enough capacity to adequately handle the waste produced, while the adequacy of three municipal plants and two industrial plants has not been determined. Operation of the sewage and

industrial waste treatment plants in this basin is considered to be satisfactory at half of the municipalities and industries for which information is available.

The large number of existing sewage treatment plants with unsatisfactory capacity is probably due to the fact that many of them have been operating for a long time. The first plant in the basin was constructed in 1905, almost 50 years ago, while 12 plants were constructed prior to 1920 and 17 additional plants were placed in operation between 1920 and 1930. Twenty-four communities have constructed new plants or made major improvements to their existing plants since 1940 and 18 municipal plants and eight industrial waste treatment plants have been constructed since 1946. Table D presents a summary of the progress made in pollution abatement in recent years.

TABLE D
PROGRESS IN POLLUTION ABATEMENT

Year	Municipal		Industrial	
	Plants Completed	Design Population	Plants Completed	Amount of Waste Treated (in terms of equivalent number of people)
1947	0	--	1	750
1948	5	5,470	1	72,000
1949	2	6,500	2	1,750
1950	2	1,075	1	50
1951	1	800	2	82,700
1952	3	2,610	0	--
1953	5	5,070	1	51,500

The work that has been and is being done to control pollution in the Minnesota River basin is very encouraging, but there are points on the streams where additional control work is needed. As already indicated, the large number of existing plants illustrates the excellent job the State water pollution control agencies are doing. The activities of these agencies are hampered, however, by lack of sufficient trained personnel and sufficient appropriations to properly expand their activities to meet the increasing problems that confront them. It will be necessary to provide adequate appropriations and competitive salary levels if efficient, well-operating pollution control organizations are to be maintained at a level that will permit continued progress in pollution abatement.

The water pollution control laws of these three States are adequate to abate existing pollution and prevent or control new or increased sources of pollution. The water pollution control agencies have been given sufficient authority to carry on their programs, and they have used this authority judiciously and effectively in carrying out their work. The following brief analysis presents the salient features of water pollution control legislation of the three States in this basin.

In Minnesota a comprehensive State water pollution control act was enacted in 1945 with authority vested in a Water Pollution Control Commission. The State Department of Health also has certain water pollution functions relating to public health and sources of water supply for domestic use. The Commission is given the power and duty to make such administrative classifications of the waters of the State as it may deem advisable and establish reasonable pollution standards of the waters of the State in relation to the public use to which they are or may be put. Also, the Commission has the power and duty to approve plans for disposal systems; to issue, continue in effect, or deny permits for the discharge of wastes or for the installation or operation of disposal systems or parts thereof; and to revoke or modify any permit, when necessary, to prevent or abate pollution of any waters of the State. The Commission is authorized to hold hearings and issue orders, if necessary, to prevent pollution. Although the Commission is a separate and distinct entity, all investigations and other staff functions

are performed by the State Department of Health. There are no geographical or functional exemptions from the operations of the State water pollution control act.

In Iowa the water pollution control act vests the principal authority in the State Department of Health. The Iowa Natural Resources Council and the State Geologist also have certain functions relating to water pollution. The Iowa Natural Resources Council makes surveys of health and pollution problems relating to flood control. The State Geologist is responsible for protection of waters from pollution by oil and gas wells.

There is no specific statutory authority granted to the State Department of Health to develop a comprehensive program, to set standards of water purity, or to classify waters. However, the Department is authorized to exercise general supervision over public health, promote public hygiene and sanitation, to investigate and prevent water pollution, and to make necessary rules. The Department is authorized to issue written permits, after approval of plans and specifications, for new sewerage or industrial waste systems as well as extensions or additions which would substantially increase water pollution. The Department may hold public hearings on water pollution and may order abatement of pollution. However, the order cannot be issued without the written approval of the majority of the members of the Iowa Natural Resources Council. Penalties are provided for violations of orders issued or for unlawful pollution of the State waters. There are no exemptions from the operation of the Act since removal in 1949 of the restrictions under which the authority of the Department did not apply to the border streams. The last amendments to the existing statutes of the State of Iowa considerably strengthened previous water pollution control legislation, under which a large measure of progress was made. Disposal of garbage and night soil into streams or on land subject to overflow is prohibited by an old statute not under direct administration of enforcement by the State Department of Health.

In South Dakota, comprehensive powers to prevent water pollution are vested in a Committee on Water Pollution Control. The Department of Health also has certain duties and powers pertaining to sewage disposal and prevention of water pollution. Technical work of the Committee relating to water pollution is done under the supervision of the Director of the Division of Sanitary Engineering of the State Department of Health. The Committee has the power and duty to classify the public waters. The Committee may investigate alleged pollution and such investigations must be made upon the written petition of certain specified persons or groups. The Committee may order the cessation of pollution after a hearing if, in its judgment, the public welfare warrants it.

The State Department of Health is authorized to adopt and enforce orders, directions, or regulations as may be designated to protect the public health in the disposal of sewage and the pollution of streams and other waters. The State Department of Health by regulation requires approval by it of the plans of any disposal system before its construction may take place.

Formal orders to municipalities and industries for abatement of pollution have not been widely used as an administrative procedure in this basin. Instead, water pollution control agencies of the States have preferred to use a cooperative approach working closely with polluters in an attempt to secure abatement without exercising police powers. Generally, formal orders have been used only in those cases where the cooperative approach has not been successful. The States also have a policy of not issuing permits for construction of new sewer systems or extensions of existing ones unless the community requesting the permit has, or is actively planning to construct, adequate treatment facilities, where such action is authorized by their respective laws.

MUNICIPAL
INDUSTRIAL
NO POLLUTION ABATEMENT NEEDS
POLLUTION ABATEMENT NEEDS UNDETERMINED
POLLUTION ABATEMENT NEEDED
POLLUTION ABATEMENT NEEDS INDICATED BY LETTERS APPEARING BY "POLLUTION ABATEMENT NEEDED" SYMBOLS, AS FOLLOWS:
A NEW TREATMENT PLANT OR OTHER POLLUTION CONTROL MEASURES
B ENLARGEMENTS OR ADDITIONS TO EXISTING PLANT
C REPLACE EXISTING PLANT
D CONNECT TO MUNICIPAL SEWER
NOTE –
Numbers next to symbols or code letters represent number of pollution abatement needs in the category designated
SCALE OF MILES
10 5 0 10 20 30 40 50
N
MINNESOTA
IOWA
S. DAKOTA
MINN.
N DAKOTA
SOUTH DAKOTA
NEB
WISCONSIN
MAP LOCATION
MINNESOTA RIVER BASIN
MUNICIPAL AND INDUSTRIAL
POLLUTION ABATEMENT NEEDS
U.S. DEPARTMENT OF
HEALTH, EDUCATION AND WELFARE
Public Health Service
MAP NO. 8

POLLUTION PREVENTION MEASURES REQUIRED

A relatively high degree of treatment is required in this basin because of the generally low stream flows during critical periods and the diversified uses of the waters. In view of the extensive use of surface water for recreation and livestock watering, pollution control measures should be such as will maintain the quality of the water at the high level necessary for these uses.

Water quality objectives which are pertinent to these and other water uses of the basin have been discussed in the section of this report entitled "Uses of Water Resources." For much of the basin, the degree of treatment required is influenced by the very limited amount of dilution water available during periods of critical low flow. During low flow periods which occur in hot weather, the water temperature rises and reduces the capacity of the stream to absorb and hold oxygen and at the same time accelerates the rate of biological activity with a corresponding increase in the amount of oxygen required to stabilize the organic material in the waste. During the winter conditions of low flow, heavy and prolonged ice cover prevents or diminishes reaeration of the stream water, and biological activities, while progressing at a slower rate than in warm weather, must be supported by the oxygen contained in the receiving waters prior to the discharge of pollution. Thus, where the quantity of waste discharge is large or where a very small volume of dilution water is available, undesirable stream conditions are accentuated unless adequate treatment is given the waste before discharge.

It seems reasonable to expect that a high degree of treatment will be essential at those points where stream flows are critical in order to keep residual pollution loadings within the stream's capacity for assimilation and to prevent nuisance conditions. To insure that treatment facilities will satisfy the requirements and to safeguard the tax-payer's investment, the State water pollution control agencies require submission of plans for approval before construction is undertaken.

Preventive and corrective pollution control measures have been determined from results of stream surveys and other readily available data of the State agencies concerned. Construction of presently needed facilities and the adoption of waste prevention measures as soon as possible will restore, preserve, and protect existing legitimate water uses and those which may materialize in the immediate future. Required control measures were determined only after thorough consideration of all water uses and are considered to be reasonable and adequate. At the same time, it should be kept in mind that the corrective measures are intended to be flexible and to reflect the needs of the existing situation. Changes in stream characteristics, pollution load, or water use may require revisions in the required treatment at some future date.

Excellent progress has been made in providing municipal and industrial waste treatment facilities, but much additional plant construction, replacement, and expansion are needed before all waters of the basin are adequately protected from the effects of pollution. There is also a need for improved operation of the plants. This failure to operate waste treatment works at the maximum efficiency for which they were designed results in clean streams not being obtained as estimated, and partial waste of funds spent in anticipation of clean streams.

Presently available information shows that there are 45 existing municipal sewage treatment plants with a total connected population of 55,313 that are considered to be adequate for present conditions; no additional treatment facilities are required for the communities served by these plants. Twenty-one of the industrial sources are reported to be disposing of their wastes in a satisfactory manner.

TABLE E
REQUIREMENTS FOR MUNICIPAL AND INDUSTRIAL
WASTE TREATMENT PLANTS

Requirements	Municipal		Industrial
	Number	Population Served by Facilities	Number
New Plant	37	55,220	14
Enlargement or Addition to Existing Plant	18	28,870	9
Replace Existing Plant	9	11,770	0
No Project Required	45	55,313	21
Undetermined	3	3,814	10

Thirty-seven new sewage treatment plants are needed to serve an estimated total of 55,220 people. There are nine existing sewage treatment plants that, because of age or gross overloading, can no longer provide a satisfactory degree of treatment and should be replaced. These plants are now serving about 12,000 people. In addition there are 18 plants now serving 28,870 people which should have additional facilities installed or which should be enlarged so that they can do an adequate job of controlling stream pollution.

[illegible]ste treatment plants are needed by 14 industries, while nine should enlarge their existi[illegible]plants or provide additional facilities. While waste treatment needs of ten industries have not been determined, the majority of these industries are small. Pollution abatement projects will be needed at some of these pollution sources, but it is believed that most of them now dispose of their waste in a satisfactory manner.

TABLE F
STATUS OF TREATMENT WORKS PROJECTS TO ABATE POLLUTION
January 1, 1954

Status of Project	Number	
	Municipal	Industrial
No Formal Action	16	11
Plans under Preparation	10	5
Final Plans Approved	20	0
Under Construction	2	2
Status Undetermined	16	5

Table F presents currently available information on the status of waste treatment projects which are known to be needed to abate water pollution in this basin. It will be noted that there is considerable activity leading toward the solution of a large portion of the basin's pollution problems with 30 municipalities and five industries having plans approved or preparing plans for approval, while two municipalities and two industries have waste treatment plants under construction. Obviously, the mere listing of the pollution abatement needs or the preparation of treatment plant plans will not correct the pollution of the basin's waters. The program must be carried forward until the needed facilities are constructed and placed in operation.

GPO 878288

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